

forest research note

1981

No. 28

Effects of Continuous Planting on Black Spruce Survival and Growth: An Interim Report

by

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Introduction

Foreseeable expansions of Ontario's wood industry will require that the total provincial forest regeneration program be expanded and become more efficient. In specific areas where the new Forest Management Agreements are in force, expansion and efficiencies may soon be realized, but in other areas labour shortages are imminent. Indeed, labour supply has been cited as the key to the future success of Ontario's total forest renewal program (Ketcheson and Smyth 1977).

Efforts to alleviate labour shortages and to contend with the need to reforest a constantly increasing land area have been partially realized through mechanization of some silvicultural processes, such as tree planting. However, in northern Ontario sites are frequently rugged and efforts to fully mechanize tree planting have been slow. Hence, labour supply will remain a critical factor in silvicultural operations and is expected to worsen in the future. Nonetheless, there are several options available to forest managers to achieve regeneration targets, one of which is artificial seeding; but at our present level of technology, only few species give consistently good results, such as jack pine (*Pinus banksiana* Lamb.). Another solution is to plant over an extended period of time, or plant continuously - techniques which are particularly suited to species of spruce. For this alternative to be successful, however, we must understand, and be able to recognize and act upon, periods of physiological activity conducive to rapid establishment for each species and stock type used for forest renewal purposes.

Hence in 1975, an investigation was initiated to elucidate the survival and growth trends exhibited by black spruce (*Picea mariana* (Mill) B.S.P.) when planted throughout the frost free season in northern Ontario. This research note is an interim report highlighting the 1976 and 1979 growth performance of a plantation established in the District of Thunder Bay.

The Field Design

In May 1975, seedling (3+0) and transplant (1½+1½) black spruce stock were lifted from nursery beds, graded, and packed into plastic lined cardboard boxes and placed in cool storage (1-3°C) at the Thunder Bay Forest Station. In addition, several production beds of rising 3+0 and 1½+1½ (designated as 2+0 and 1½+½ respectively) black spruce were reserved for fresh lifting.



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A communication of the Ontario Forest Research
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The Head, Ontario Forest Research Centre, Ministry
of Natural Resources, March 2nd, 1981.

On each of the 12 bi-weekly planting dates, seedling and transplant stock were removed from cool storage, repacked into open plastic lined boxes with roots in moist sphagnum moss. Fresh reserve stock was carefully dug from nursery beds and similarly packed for transport. Damaged trees were discarded as were excessively large and small trees.

The planting site was located in the vicinity of Muskeg Creek, 100 km northwest of Thunder Bay in the Dog River Working Circle of Great Lakes Forest Products Ltd. The site is a boulder till overlain by loess of variable depth and has a fresh moisture regime. The area once supported a productive stand of black and white spruce (*Picea glauca* (Moench) Voss), balsam fir (*Abies balsamea* L.) and poplar (*Populus tremuloides* Michx.). In the year prior to planting the site was prepared by burning.

Plantings began May 20th and terminated October 21st. In the field, the trees were planted in a triplicated split-plot experimental design with planting dates representing the 12 main plots and the four stock types (stored $1\frac{1}{2}+1\frac{1}{2}$, and $3+0$; fresh $1\frac{1}{2}+\frac{1}{2}$ and $2+0$) representing the sub-plots. Planting dates were randomly located within each replication and stock treatments similarly randomized within planting dates. Trees were planted 2 m apart beside wooden stakes located at 2 m intervals along planting lines. Microsites were prepared by scalping away duff from the surface down to the upper A_e horizon and planting was done carefully using the L-slit method and ensuring that tree roots were adequately dispersed in the slit. Twenty-five trees of each stock type were planted at each planting date and in each replication, resulting in 3 600 trees in the plantation. During the fall of each year following planting, all surviving trees were assessed for total height and current annual height increment.

Results

Survival. Figure 1A shows clearly that 1976 survivals of spring stored and fresh lifted transplant stock were high (>90%) for plantings made before August 25th (Planting 8). Survival of fresh lifted stock planted thereafter remained consistently high whereas survival of spring stored stock decreased rapidly as planting continued. Similar survival trends can be noted for spring stored and fresh lifted seedling stock with few exceptions (Fig. 1B), notably, the sudden decrease in survival for the July 14th planting (Planting 6) and the planting date at which the survival of the spring stored stock began to decline, i.e. after August 11th. Survival after the 1979 growing season for each stock type was generally less for each planting date but not significantly (Fig. 1A and 1B).

Current Annual Height Increment. Current annual height increment as it is used here, as a performance indicator, has been adjusted to account for mortality and hence plotted values are not true treatment means. Adjustments were made by summing the annual height increments of the living trees for each stock type and planting date then dividing by 25, the original number of trees planted for each treatment.

Adjusted current annual increments during 1976 for stored and fresh transplant stock are distinctly different (Fig. 1C). As planting continued into the growing season growth of fresh transplant stock decreased until July 14th (Planting 5), after which it increased consistently with one exception until October 21st. In contrast, growth of stored transplant stock increased as planting continued up until June 30th (Planting 4) then decreased abruptly to October 21st. It should be noted that in this case the rapid decline in the adjusted current annual height increment is also due to the rapid decline in survival, and thus does not reflect the mean increment of the living trees.

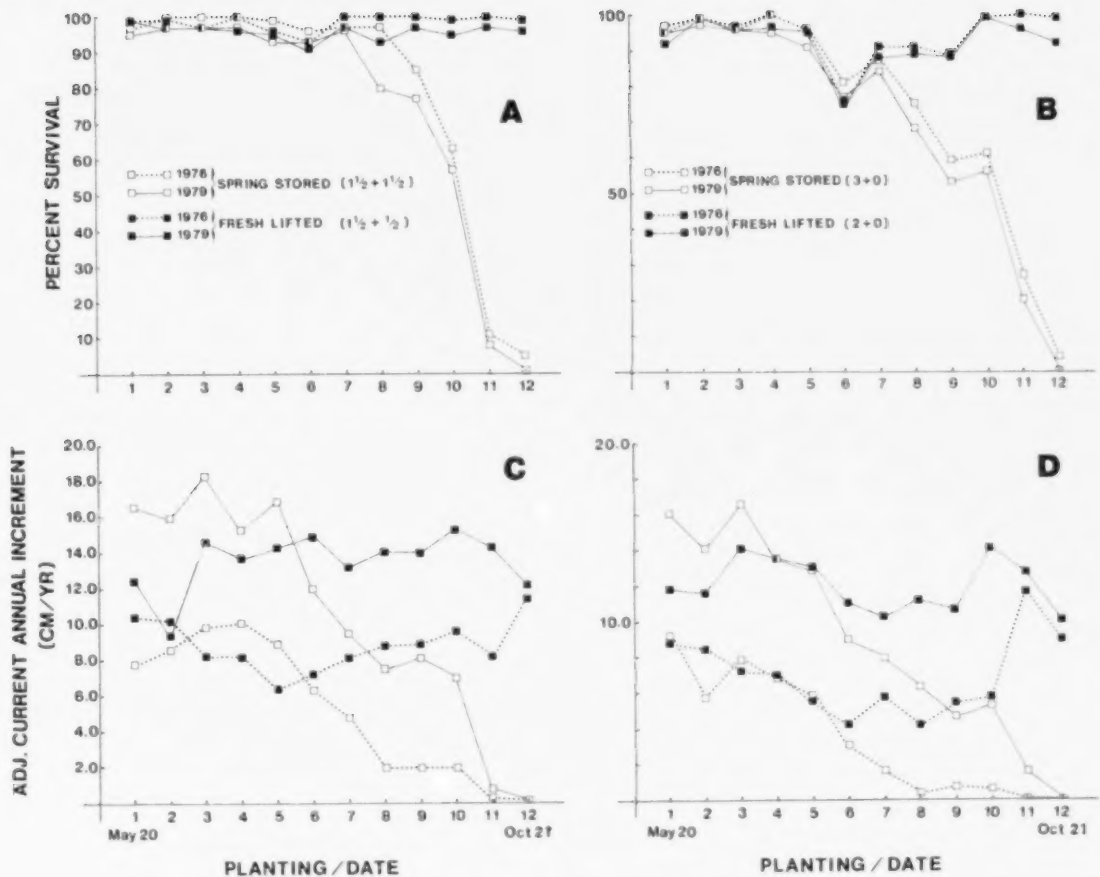


Figure 1 1976 and 1979 survival of spring stored and fresh lifted transplant and seedling black spruce in relation to time of planting (1A & 1B) and associated adjusted current annual increments (1C & 1D).

In Figure 1D, 1976 adjusted current annual height increment for stored and fresh stock continued to decline from an early spring high (May 20th) to July 28th after which height increment of fresh stock increased slowly, then abruptly in October. Beyond July 28th (Planting 3) height continued to decrease as planting proceeded.

In 1979, adjusted current annual increments of all four stock types increased substantially over 1976 values at each planting date. Interestingly, stored transplant and seedling stock maintained their dominance in growth over fresh stock for the early plantings but the trend is reversed as it was in 1976. Furthermore it is notable that the adjusted current annual height increments of seedling stock for the same early period were marginally less than those of the transplant stock.

Discussion

Black spruce seedlings and transplant nursery stock demonstrated varying capacities to survive and grow in relation to nursery treatment and time of planting. This information on the pattern of survival of each stock type and its associated current annual height increment is necessary for initially designing a fully integrated regeneration program by planting. It is emphasized that the choice of species of conifer to plant must not be

based solely on rate of survival as it can be misleading. For example, despite the extended period over which stored transplant black spruce exhibited high survival (80% up until Planting 9), the rate of height increment remained severely depressed compared to earlier spring plantings. Used in combination, survival and growth indicate that spring stored $1\frac{1}{2}+1\frac{1}{2}$ stock could be planted until the end of July for best performance. Continued planting of this stock is not recommended because of lower expected plantation performance (low survival and poor growth). For planting beyond the end of July, one should consider the use of freshly lifted stock: survival capability is continuously high and current annual height increment one year after planting could be expected to increase with lateness of planting. The same consideration given to transplant stock should be given to seedling stock in judging its value for use in a continuous planting program.

Since considerable, but not impractical care was taken when fresh trees were lifted, packed, transported and planted in the field, it is impossible to state to what extent the relationships of survival and growth to time of planting would change with operational planting, but anything less than best care might lower the performance level of the plantation. As the planting season progresses, handling procedures and planting becomes critical to survival and subsequent growth.

A truly integrated regeneration program implies that all species normally planted be considered for the program. The interim results reported in this research note represent only a segment of the total information required to design a practical continuous planting program. Work with other species e.g. white spruce (Lyon 1980), jack pine, black and white spruce (Sutton 1980) has advanced and it now remains for the available data to be pooled to develop a tentative integrated planting program. Container stock must also be considered. Refinements will come when assessments of the effects of factors such as soil moisture regime, slash accumulation, site preparation treatment, and stock type on survival and growth are completed.

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